NISTTech

Applying Adhesives with Optical Tweezers

Temporarily or permanently bond nanoscale to microscale objects using holographic optical tweezers

Description

Nanotech manufacturers and researchers may need to attach together, either temporarily or permanently, very tiny structures. Until now it was very hard to control on a nanoscale level how much and where to apply the glue. Researchers at the National Institute of Standards and Technology (NIST) developed a technique to temporarily or permanently glue together tiny nanoparticles using optical tweezers.

Optical tweezers use microscopically focused laser light to manipulate very small objects. A highly focused laser beam, like a microscopic 'hand', gives tiny pushes or pulls to nanoscale objects and can hold these objects in an area called an optical trap. Holographic optical tweezers split a laser beam into many parts create many 'hands', each which can manipulate an object of interest held in a trap.

The NIST technique takes advantage of adhesives with special heat or light curing abilities to glue objects such as nanowires together. Researchers first make a mixture of nanosized adhesive balls of partially light-cured drops of adhesive and suspend them in an optical trap. The mixture also contains nanowires held closely together by holographic optical tweezers. Increasing the laser energy or intensity in one of the optical tweezers causes the tips of the nanowires to heat up, and starts the adhesive balls flowing across the nanowires. Some of the adhesive balls melt and stick as they touch the heated wires eventually gluing the nanowires together.

Applications

- **Nanomanufacturing and nanoresearch**
  For binding together objects using holographic optical tweezers

Advantages

- **Bonds nanoscale objects**
  Glues or unglues objects in the nanometer to micrometer scale using heat and light controlled adhesives
- **Versatile**
  Works on similar or dissimilar objects without the need of surface preparation

Abstract

This document describes a method for bonding two or more objects using nanometerscale to micrometer-scale adhesive particles manipulated and cured by optical tweezers, including holographic optical tweezers.

A system and method for bonding and unbonding of small objects using small adhesive particles. The system and method includes the use of a plurality of optical tweezers to manipulate objects to be bonded and adhesive particles suspended in a fluid. The objects to be bonded (or unbonded) and the adhesive particles are positioned by lower power optical tweezers and then an intense bonding optical tweezer is activated to cause the adhesive to join the objects together (or used to unbond objects).

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Citations

1. R. Agarwal, K. Ladavac, Y. Roichman, G. Yu, C.M. Lieber, and D.G. Grier. Manipulation and assembly of nanowires with holographic optical traps. Optics Express, Vol. 13, Issue 22, pp 8906-8912, 2005.

References

- U.S. Patent #7,678,222
- Docket: 05-014US

Status of Availability

This invention is available for licensing.

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